METHOD AND SYSTEM FOR GATHERING DATA USING AUTOMATIC APPLIANCE FAILOVER

Field Of The Invention

[0001] The invention relates to gathering performance data for a plurality of devices communicating with a central controller via a plurality of appliances. More particularly, the invention relates to load balancing and failover services requiring little or no client involvement, and will be described with particular reference thereto. It will be appreciated, however, that the present invention is also amenable to other like applications.

Background Of The Invention

[0002] Reliable operation of devices (e.g., printers) within a computing network requires that certain parameters (e.g., status and usage) of the devices be monitored on a regular basis (e.g., weekly or even daily). A central controller evaluates the parameters gathered for the various devices during the monitoring process for scheduling maintenance and/or identifying devices that need immediate service.

[0003] Conventionally, the monitoring process includes surveying the network for identifying all of the devices and, furthermore, the respective network addresses of the identified devices. Since not all of the devices are capable of communicating with each of the other devices in the network, a mapping is then performed for identifying which of the devices are capable of communicating with each other. The mapping is transmitted to the central controller. Importantly, the mapping is merely a manual process performed by an operator and is based on the addresses of the devices within the network. Therefore, the operator typically relies on predetermined assumptions for determining which devices are capable of communicating with each other. For example, devices having similar addresses may be assumed to communicate with one another. However, because such assumptions are not always accurate, the mapping is often incorrect.

[0004] Once the central controller receives the mapping information, certain ones of the devices are designated as data collection devices. The data collection devices are chosen such that each of the devices in the network communicates with at least one of the data collection devices. Next, each of the devices is associated with one of the data collection devices. In this manner, assuming that each of the data collection devices monitors itself, each of the devices is monitored by the central controller via one of the data collection devices. Load balancing is achieved by associating approximately equal numbers of devices to the data collection devices.

[0005] Each of the data collection devices includes a software program that, when executed, evaluates the status of the respective associated devices. Data (e.g., usage data or diagnostic data used for scheduling maintenance and/or repairs) gathered by the data collection devices is transmitted to the central controller via, for example, e-mail. The central controller dispatches maintenance and/or repair orders according to previously determined criteria.

[0006] There are several drawbacks to the conventional process for gathering the desired device usage data. For example, because the central controller does not actually control the data collection devices, the operators of the data collection devices must manually execute the program to gather the desired data. Since the data collection process can be time consuming, operators of the data collection devices typically only initiate the program on an infrequent basis (e.g., monthly). Consequently, devices requiring immediate repair may not be identified on a timely basis.

[0007] Another drawback to the conventional process is evident when one or more of the data collection devices fails. In this case, the central controller cannot redirect a remaining one of the other data collection devices to gather the status data from the devices associated with the failed data collection device.

[0008] Furthermore, as discussed above, because the mapping between the data collection devices and other devices is not always accurate, the central controller may not receive status data from all of the devices in the network.

[0009] The present invention provides a new and improved apparatus and method which overcomes the above-referenced problems and others.

Summary Of The Invention

[0010] In one embodiment of the present invention, a method for configuring data communication paths between a central controller and a plurality of devices is provided. The method ensures a first appliance is active. For each of the devices, a first communication capability is determined between the first appliance and the device. Signals indicative of the first communication capabilities are transmitted to the central controller. Respective communication paths are mapped between the central controller and the devices via the first appliance as a function of the first communication capabilities to obtain automatic appliance failover.

[0011] In another aspect of the present invention, a method is provided for gathering diagnostic data, which are associated with a plurality of devices, within a central processing unit. A determination is made as to which of a plurality of intermediate collectors are capable of communicating with the respective devices. A notification signal is received within the central processing unit that one of the intermediate collectors is available. One of the devices is identified for which the diagnostic data is desired. A determination is made as to whether the identified device is capable of communicating with the available intermediate collector. If the identified device is capable of communicating with the available intermediate collector, a request signal is transmitted from the central processing unit to the available intermediate collector requesting the diagnostic data for the identified device. Signals indicative of the diagnostic data are transmitted from the identified device to the central processing unit via the available intermediate collector. In this manner, automatic intermediate collector failover is obtained.

[0012] In another aspect of the present invention, a plurality of signals executable on a computing device, including a plurality of appliances, a plurality of devices, each of which communicates with at least one of the appliances, means for ensuring each of the appliances is active, means for determining which of the

appliances communicate with the respective devices, and a central controller, which communicates with each of the appliances, include a notification signal and an identification signal. The notification signal is transmitted to the central controller and indicates that one of the appliances is available. The identification signal identifies at least one of the devices capable of communicating with the available appliance for which the diagnostic data is desired. In this manner, automatic appliance failover is obtained.

Brief Description Of The Drawings

[0013] In the accompanying drawings which are incorporated in and constitute a part of the specification, embodiments of the invention are illustrated, which, together with a general description of the invention given above, and the detailed description given below, serve to example the principles of this invention.

[0014] FIGURE 1 is an exemplary overall system diagram for gathering diagnostic data in accordance with the present invention;

[0015] FIGURE 2 is an exemplary methodology of gathering diagnostic data in accordance with the present invention; and

[0016] FIGURE 3 is an exemplary methodology of ensuring the appliances are active in accordance with the present invention.

Detailed Description Of Illustrated Embodiment

[0017] The following includes definitions of exemplary terms used throughout the disclosure. Both singular and plural forms of all terms fall within each meaning:

[0018] "Computer Readable Medium", as used herein, includes but is not limited to any memory device, storage device, compact disc, floppy disk, or any other medium capable of being interpreted by a computer.

[0019] "Software", as used herein, includes but is not limited to one or more computer executable instructions, routines, algorithms, modules or programs including separate applications or from dynamically linked libraries for performing functions and actions as described herein. Software may also be implemented in various forms such as a servlet, applet, stand-alone, plug-in or other type of application. Software can be maintained on various computer readable mediums as is known in the art.

[0020] "Signals", as used herein, includes but is not limited to one or more signals, a bit stream, an algorithm, a routine, a program or the like. The term "commands" is synonymous with "signals."

[0021] "Network", as used herein, includes but is not limited to the internet, intranets, Wide Area Networks (WANs), Local Area Networks (LANs), and transducer links such as those using Modulator-Demodulators (modems).

[0022] "Internet", as used herein, includes a wide area data communications network, typically accessible by any user having appropriate software.

[0023] "Intranet", as used herein, includes a data communications network similar to an internet but typically having access restricted to a specific group of individuals, organizations, or computers.

[0024] Illustrated in FIGURE 1 is an exemplary overall system diagram in accordance with the present invention. One embodiment of a system **10** for gathering diagnostic data signals includes a local site **12** that communicates with a remote site **14** via an external network **16** (e.g., an Internet). As will be discussed in more detail below, the remote site **14** includes a central controller **20** that communicates with the external network **16**. Optionally, the central controller **20** communicates with the external network **16** via a remote site firewall **22**. The central controller **20** includes a central processing unit **24** and a storage device **26**.

[0025] The local site **12** includes a plurality (e.g., four (4)) of appliances **30a, 30b, 30c, 30d** that communicate with the central controller **20** via the external network **16** and, optionally, a local site firewall **32**. In the illustrated embodiment,

the appliances **30** are typically "headless" computers, which include central processing units (but no keyboards or monitors), that are controlled by the central controller **20** via the external network **16**. In this sense, the appliances **30** are slaves to the central controller **20**. A plurality (e.g., six (6)) of devices **34a, 34b, 34c, 34d, 34e, 34f**, which in one embodiment are output devices (e.g., printing devices), communicate with the appliances **30** via an internal network **36** (e.g., an intranet). In the illustrated embodiment, the number of devices **34** typically exceeds the number of appliances **30**. However, other embodiments, in which the number of devices is less than or equal to the number of appliances, are also contemplated.

[0026] In the illustrated embodiment, the devices **34** at the local site **12** are manufactured and/or maintained by the remote site **14**. Therefore, the central controller **20** gathers data used to schedule maintenance and/or repairs for the devices **34**. The data gathered by the central controller **20** is diagnostic data signals transmitted from the devices **34** to the central processor **20** (via the appliances) according to a method described below. Typically, the diagnostic data signals provide information describing how much each of the devices has been used (e.g., usage data) and/or problems that have developed with the devices that have not been corrected.

[0027] Illustrated in FIGURE 2 is an exemplary computer-implemented methodology of gathering data used to schedule maintenance and/or repairs in accordance with the present invention. The blocks shown represent functions, actions or events performed therein. It will be appreciated that computer software applications involve dynamic and flexible processes such that the illustrated blocks can be performed in other sequences different than the one shown. It will also be appreciated by one of ordinary skill in the art that the software of the present invention may be implemented using various programming approaches such as procedural, object oriented or artificial intelligence techniques.

[0028] With reference to FIGURES 1 and 2, the process for gathering data used to schedule maintenance and/or repairs for the devices **34** begins in a block **100**. A determination is made, in a block **102**, as to which of the appliances **30** are

capable of communicating with the respective devices **34**. In one embodiment, the means for determining implemented in the block **102** involves the appliances **30** "pinging" the devices **34** (transmitting respective detection signals (ping signals)) and waiting for respective responses. If, for example, the appliance **30a** hears a response to the ping sent to the device **34c**, it is determined that the appliance **30a** is capable of communicating with the device **34c**; otherwise, it is determined no communication is possible between the two components. Although "pinging" is used as the means for determining which of the appliances communicate with the respective devices, other means (e.g., manual means) are also contemplated.

[0029] Signals (identification signals) indicative of the communication capabilities are transmitted, in a block **104**, from each of the appliances **30** to the central controller **20** and stored in the storage device **26**. Respective communication paths are mapped, in a block **106**, between the central controller **20** and each of the devices **34** as a function of the communication capabilities. More specifically, if the communication capability signals transmitted in the block **104** indicate that the device **34a** is capable of communicating with the central controller **20** via two (2) of the appliances **30b, 30d**, two communication paths are mapped between the central controller **20** and the device **34a** in the block **106**.

[0030] In one embodiment, each of the appliances **30** and the devices **34** is identified by respective network identifiers (e.g., addresses). Consequently, the signals transmitted in the block **104** include the addresses of each of the appliances **30** along with the corresponding devices **34** with which the appliances **30** can communicate. In this case, the mapping block **106** stores a list of identifiers in the storage device **26**. The list of identifiers indicates which devices **34** are capable of communicating with the respective appliances **30**.

[0031] The pings sent from the appliances **30** are useful for providing additional information about the communication capabilities. For example, the number of routers **40** (or hops) between the appliances **30** and the respective devices **34** is typically encoded in the response to the ping. FIGURE 1 illustrates six (6) routers **40** between the appliance **30a** and the device **34d**. Fewer routers may mean there is less probability one of the routers in the path between the

appliance and the device will become unavailable (i.e., go "down"). Furthermore, the appliance **30** may determine the length of time that passes before receiving the response. A shorter length of time between the time the ping was sent and the time a response was received may indicate faster responses in the future (even if the signal passes through more routers). The number of routers between the appliance and device and/or the length of time that elapses between the ping and a corresponding response is optionally used by the central controller **20**, in a block **108**, for determining an optimal path. The optimal path represents a preferred path between the central controller **20** and a device **34**. Depending on the criteria used (e.g., fewest number of routers or shortest time), only one of the appliances **30** is selected in the block **108** as providing the optimal path between the central controller **20** and the respective device **34**.

[0032] The central controller **20** sends a command to each of the appliances **30**, in a block **112**, that instructs the appliances **30**, upon becoming available, to notify the central controller **20**. Then, in a block **114**, the central controller **20** waits to receive a notification from one of the appliances **30**. Upon becoming available, one of the appliances **30** (e.g., the appliance **30c**) notifies the central controller **20** in a block **116**. After receiving the notification, the central processor **20** identifies, in a block **118**, one or more of the devices **34** for which the diagnostic data signals are desired. Then, in a block **122**, the central controller **20** determines which of the identified devices **34** is/are capable of communicating with the available appliance **30c**. In one embodiment, the determination is made by comparing the device and appliance identifiers according to the communication capability mapping stored in the storage device **26** during the block **106**. Optionally, the block **118** determines that only the identified devices **34** having an optimal path with the available appliance **30c** communicate with the appliance **30c**.

[0033] In a block **124**, the central controller **20** balances the device loads across the appliances **30**. More specifically, if five (5) of the devices **34a, 34b, 34d, 34e, 34f** are identified in the blocks **118, 122**, the central controller **20** optionally determines in the block **124** that the desired diagnostic data signals may be gathered more efficiently by utilizing other ones of the appliances **30a, 30b, 30d, 30e** (rather than the appliance **30c**) as those appliances become available in

the future. For example, if the device **34a** and the devices **34b, 34e** communicate with the appliances **30b, 30e**, respectively, the central controller **20** may execute instructions (signals) to delay gathering the diagnostic data signals for those devices **34a, 34b, 34e** until the appliances **30b, 30e** become available (even if the appliances **30b, 30e** do not offer the optimal paths to the devices **34a, 34b, 34e**). Therefore, the currently available appliance **30c** will only be used to gather data signals for the devices **34d, 34f**. In this manner, the device loads are balanced across the appliances **30**.

[0034] As discussed above, the appliances **30** notify the central controller **20** of availability to retrieve diagnostic data signals. Furthermore, each of the appliances **30** is typically capable of communicating with a plurality of the devices **34**. Therefore, if any of the appliances **30** become disabled (e.g., go "down"), there is a high probability that the central controller **20** is capable of communicating with the devices **34** mapped to the disabled appliance via the other appliances. Such flexibility is referred to as automatic appliance failover.

[0035] With reference to automatic appliance failover, the central controller **20** is never actually notified that one of the appliances **30** is disabled. Instead, with reference to FIGURES 1-3, the central controller **20** provides a means for ensuring each of the appliances is active. More specifically, the block **114** of waiting includes determining, in a block **200**, within the central controller **20**, a length of time since receiving a notification from each of the appliances **30**. A determination is made, in a block **202**, whether the predetermined length of time for a particular appliance has been exceeded. If the predetermined time has not been exceeded, control returns to the block **200**. If, on the other hand, the predetermined time has been exceeded, control passes to a block **204** for identifying the respective appliance as disabled. Then, in a block **206**, the devices **34** that have an optimal path to the central controller **20** via the disabled appliance (i.e., the devices associated with the disabled appliance) are identified. The devices identified in the block **206** are noted, in a block **208**, so that the block **118** will not require the central controller **20** to communicate with those devices via the respective optimal paths. Then, in a block **210**, a determination is made whether the central controller **20** has received notification from any of the disabled

appliances. If the central controller **20** has not received such notification, control returns to the block **200**; otherwise control passes to a block **214**. In the block **214**, the previously disabled appliance is identified as active. Then, in a block **216**, the devices associated with the previously disabled appliance are noted so that the block **118** may require the central controller **20** to communicate with those devices via the respective optimal paths. Control then returns to the block **200**. In this sense, the system **10** automatically provides failover when any of the appliances **30** become disabled. In other words, if an appliance becomes disabled, and the central controller **20** communicates with one of the devices via an optimal path including the disabled appliance, the system **10** automatically retrieves the desired diagnostic data signals from the device via another one of the appliances.

[0036] With reference again to FIGURES 1 and 2, once a final determination of the devices (e.g., the devices **34d, 34f**) for which information is to be gathered is made in the block **124**, the central controller **20** transmits, in a block **126**, a signal indicating a request to the available appliance **30c** to gather the diagnostic data signals from the devices **34d, 34f**. The signals indicative of the requested diagnostic data are transmitted from the devices **34d, 34f** to the central controller **20** via the available appliance **30c** in a block **128**. In one embodiment, the appliances **30** gather the diagnostic data signals before transmitting the signals to the central controller **20**. Therefore, the appliances **30** act as intermediate data collectors and, furthermore, automatic intermediate data collector failover is achieved in a similar manner to the automatic appliance failover described above.

[0037] A determination is made, in a block **132**, whether to continue gathering the diagnostic data signals. If more diagnostic data signals are required, control returns to the block **114**; otherwise, control passes to a block **134** for stopping the process.

[0038] Because the central controller **20** is automatically notified whenever the appliances **30** become available, the process for gathering the diagnostic data signals is controlled by the central controller **20**. More specifically, the central controller **20** sends a request to the available appliances **30** on a regular basis (e.g.,

weekly). Therefore, devices requiring maintenance/repair are identified on a timely basis.

[0039] As discussed above, the local and remote sites **12, 14**, respectively, communicate with the external network **16** via firewalls **32, 22**. The firewalls **32, 22** provide security by limiting unauthorized access to the local and remote sites **12, 14**, respectively, from the external network **16**.

[0040] While the present invention has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art. For example, although the invention has been described as including a local site having devices, which are monitored by a central controller at a remote site, it is to be understood that the devices and central controller may be located locally with respect to each other. Therefore, the invention, in its broader aspects, is not limited to the specific details, the representative apparatus, and illustrative examples shown and described. Accordingly, departures may be made from such details without departing from the spirit or scope of the applicant's general inventive concept.